

# NEURAL CONTROL & CO-ORDINATION

↓  
funct. of organ/organ syst.  
in our body must be co-ord.  
to maintain homeostasis.

↓  
Process through which two  
or more organ interact  
& complement the funct. of  
one another.

\* The neural system provides an organised network of point to point connections for a quick co-ordination.

NEURAL SYSTEM → of all animals

↓ composed of

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highly specialised cells "neurons"

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↓  
can detect, receive,  
transmit diff. kinds  
of stimuli.

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Lower invertebrate → very simple neural organizat.

↓

Hydra: network of neurons (Nerve net)

Insects: Better organised

① Brain with a no. of ganglia  
② &  
③ neural tissue

\* The neural system co-ordinates & integrates ① functions as well as ② metabolic & ③ homeostatic activities of all the organs.

Endocrine system + Neural system



jointly coordinate & integrate all  
the activities of the organs  
so that they function in an  
synchronized fashion.



# HUMAN NEURAL SYSTEM:

CNS

(central)

Brain

Spinal cord

Site of information processing & control.

PNS

(peripheral)

Brain & spinal cord se related saari nerves.

afferent fibres

efferent fibres

organ

(impulse) → CNS

CNS (impulse) → organ

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PNS

① Somatic neural Syst.

Relays neural system impulse from CNS to skeletal muscles.

② Autonomic neural syst.

Relays impulse from CNS to involuntary organs & smooth muscles of the body

Sympathetic

Parasympathetic

\* Visceral nervous system is a part of the peripheral nervous system that comprises whole complex of nerves, fibres, ganglia & plexus by which impulses travel from the central nervous system to the viscera & from the viscera to CNS.



# Generation & Conduction of Nerve Impulse

Neurons → excitable cells → their memb. are polarised

Diff. types of ion channels are selectively permeable to diff. ion  
↳ on neural membrane.

Resting state: the axonal memb. comparatively more permeable to potassium ( $K^+$ ) ions & nearly impermeable to  $Na^+$  & negatively charged protein in axoplasm.

from out to in

Result

Axoplasm →  $K^+ \uparrow$ , -ve prot.  $\uparrow$ ,  $Na^+ \downarrow$

Fluid outside →  $K^+ \downarrow$ ,  $Na^+ \uparrow$

→ ionic gradient

↳ maintained by active transport of ions

↓ by

sod. pot. pump

- 3  $Na^+$  out of the cell
- 2  $K^+$  into the cell

Result

outer surface

↓  
+ve charged

inner surface

↓  
-ve charged

POLARISED STATE

The electrical p.d across the plasma membrane → resting potential



Stimulus applied at site A

① Freely permeable to  $\text{Na}^+$

Rapid influx of  $\text{Na}^+$

Reversal of polarity at that site.

outer surf. inner surface

-ve +ve.  
DEPOLARISED

\* The electrical pot. difference across the plasma memb. at A  
→ Action potential. → nerve impulse

At sites immediately ahead of, at B

outer surf. → +ve charge  
inner surf. → -ve charge

Current flows → inner surface  
A → B

outer surface  
B → A

"circuit completed"

Polarity reversed

action pot. is generat. at B

Impulse arrives at B & soon.....

\* Rise in stimulus induced permeability to  $\text{Na}^+$  → extremely short

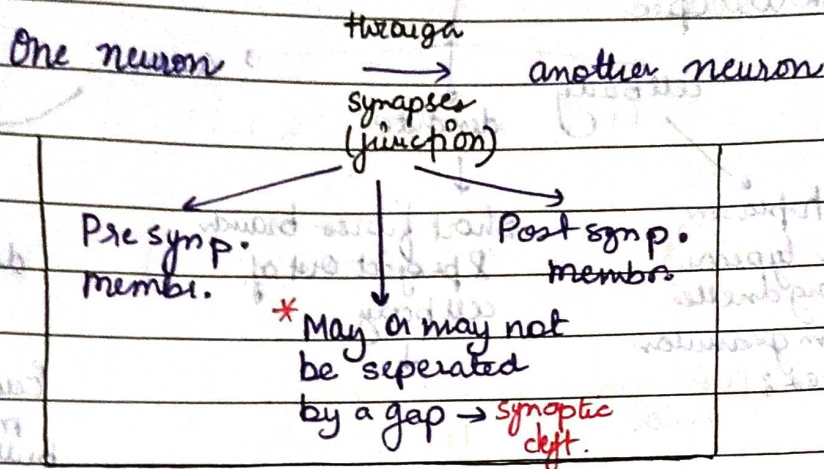
↓ quickly followed by

Rise in permeability of  $\text{K}^+$

Within fraction of second,  $\text{K}^+$  diffuses outside the membrane & restores the resting potential of the membrane at site of excitation & fibres become once more responsive to further stim.



# Transmission of Impulses



## Synapse

### Electrical synapse

- Membranes are separated by fluid filled synaptic cleft.
- inside vesicle of axon term.

Neurotransmitter / chemicals involved

- Impulse arrives at axon term. stimulates movem. of synapt. vesicle towards membrane where they fuse with the plasma membrane

Release neurotransmt. in synaptic cleft.

Neurotransmt. bind to specific receptors, on post-synaptic membrane.

This binding opens ion channel allowing entry of ions which generate new pot. in post synp. neuron. The new potential develop. may be excitatory or inhibitory.

### Chemical synapse

- Pre & Post synp. memb.

very close proximity

- Electrical current. can flow directly from one neuron into the other across these synapse.

- Transmission across elect. synapse similar to along a single axon.

- Faster.

- Rare in our system.

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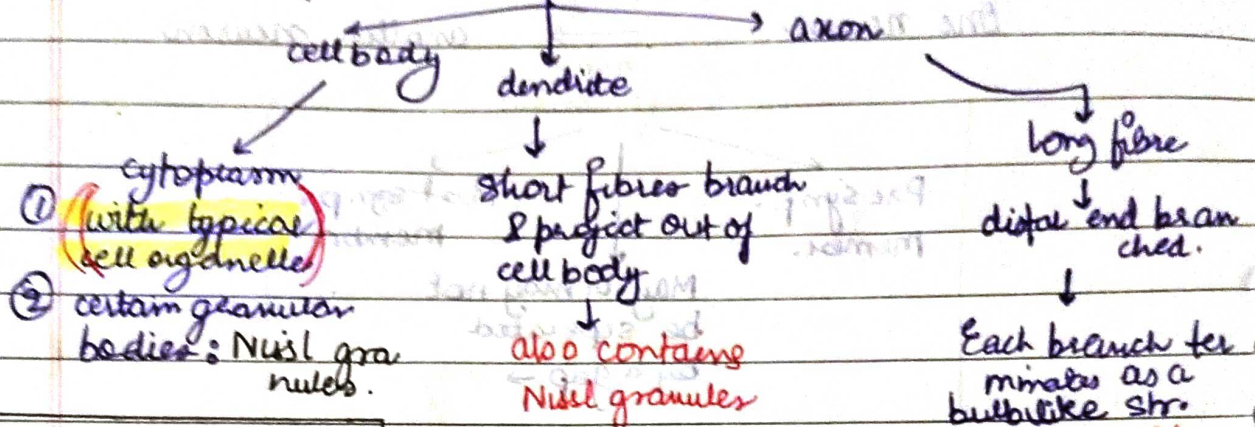
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# NEURON

↳ microscopic



Based on number of axon & dendrites

\* These fibres transmit impulses towards cell body.

Multipolar

One axon & two or more dendrites

In cerebral cortex

Unipolar

cell body with one axon

embryonic stage

Bipolar

one axon, one dendrite

Retina of eye, olfactory epithelium

Transmits nerve impulse away from cell body to a

- 1) synapse
- 2) neuromuscular junct.

## AXON

Myelinated

enveloped with Schwann cell.

forms myelin sheath around axon

Gap b/w two adjacent myelin sheath → nodes of Ranvier

spinal nerves  
cranial nerves

(CNS)

Non myelinated

enveloped with Schwann cell

DO NOT FORM Myelin sheath around axon

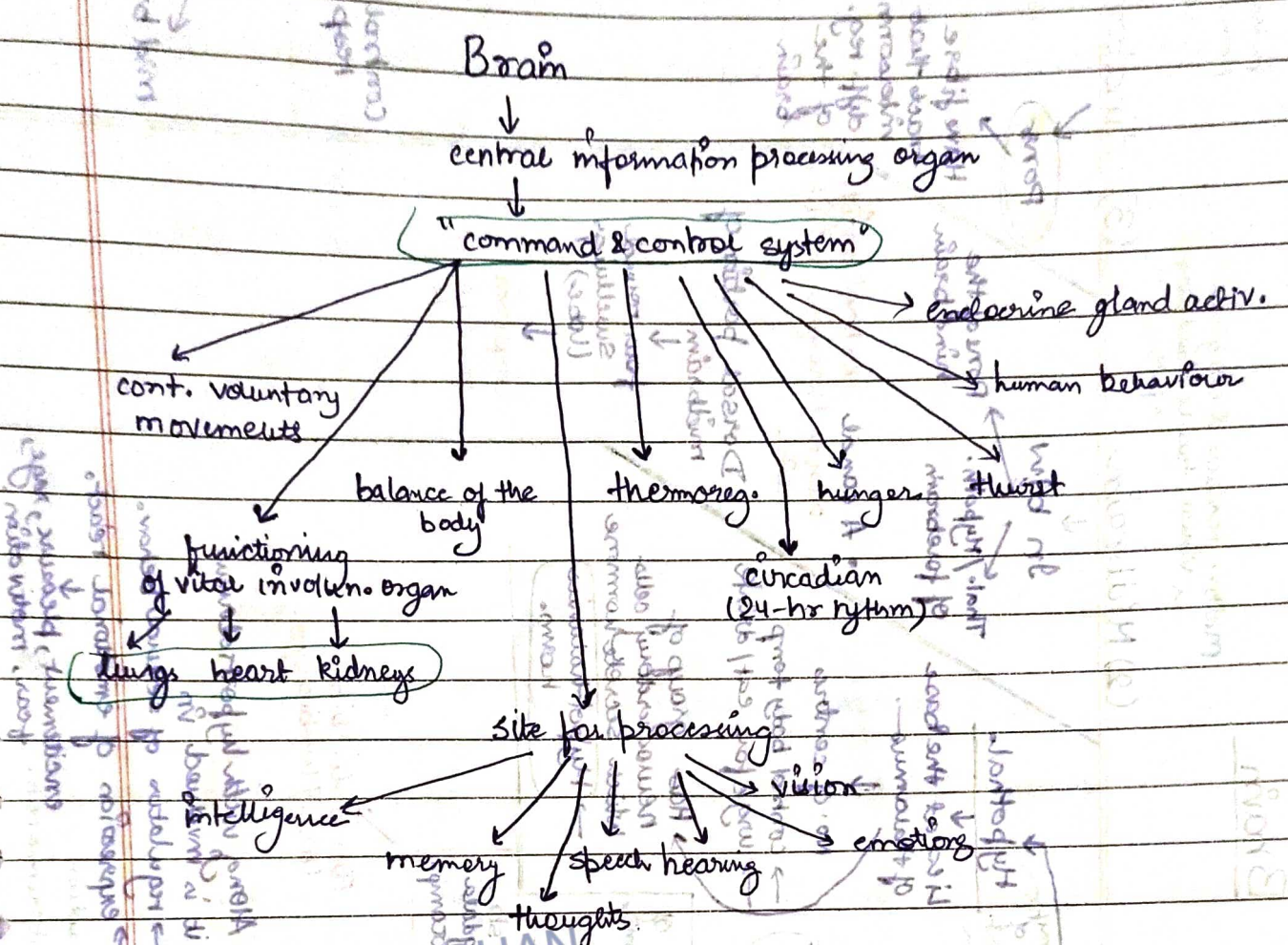
Autonomic nerve syst.

somatic nerve syst.

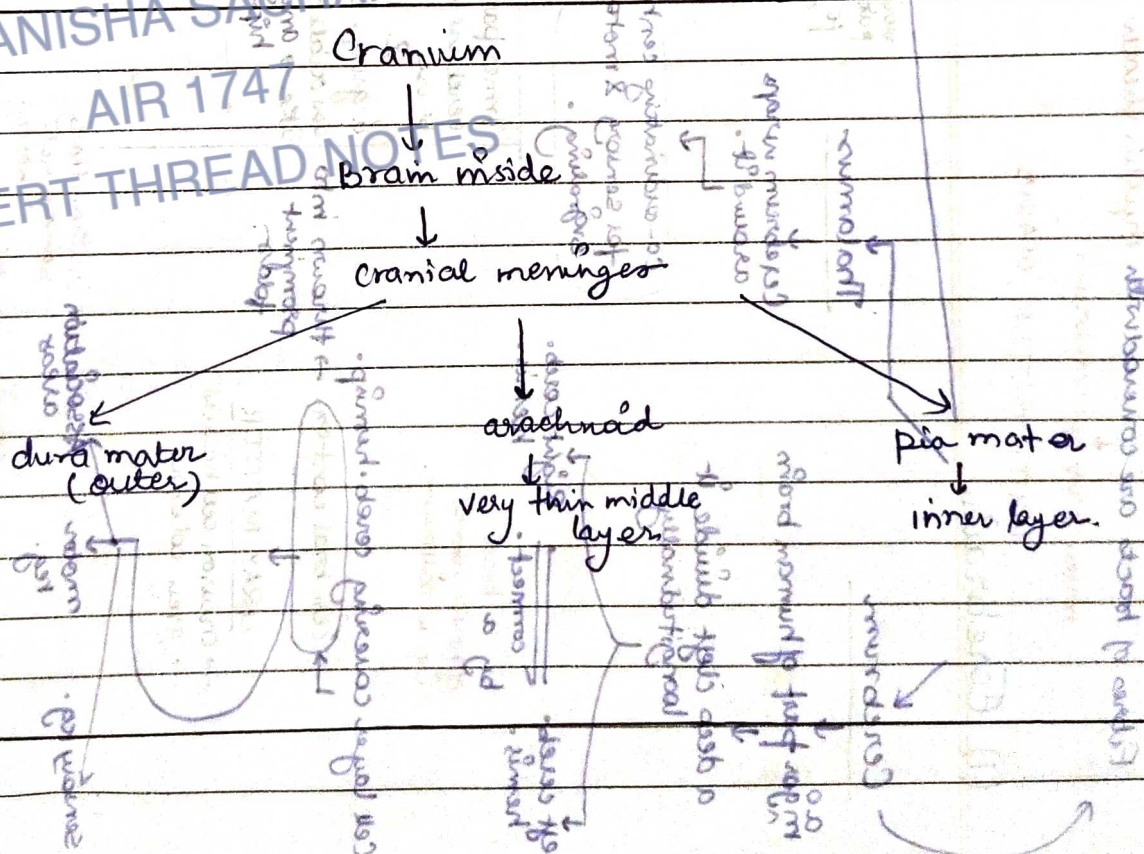
(PNS)



# CENTRAL NEURAL SYSTEM



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# Brain

## (1) Cerebrum

Fibres of both are covered with myelin sheath  
 most part of cerebrum  
 WHITE MATTER / OPAQUE

Cerebrum

as a major part of human brain

a deep cleft divide it longitudinally

Left cereb. hemisphere.  
 Right cereb. hemisphere.

connect. by a tract of nerve fibres corpus callosum.

Cell layer covering cereb. hemisph.

cerebral cortex

→ thalamus in to prominent folds

GRAY MATTER

→ neuron cell bodies  
 → grey colour.

Sensory reg.

motor reg.  
 Association (higher, clearly aware sensory motor)

complex function  
 intrinsically running association common.

Thalamus

Cerebrum wraps around it.

Co-ordinating centre for sensory & motor signaling.

very imp part of foreb. diencephalon  
 Hypothalamus

Lies at the base of thalamus.

No. of centres control body temp urge for eat/drink

Hides group of neurosecretory cells which secrete hormones

Hypothalamus

Inner part of cereb. hemisph. there is a group of associated str. like amygdala hippocamp.

Forms limbic lobe / limbic sys.

Along with hypothalamus it is involved in

- ① → regulation of sexual behavior.
- ② → expression of emotional react.
- ③ → glandular secretions of pleasure, rage, autonomous resp. from stimulation

## (2) Midbrain

midbr. receives & integrates visual, tactile & auditory inputs.

In brain

Thal./Hypoth.

Pons of the hind brain

A canal cerebral aqueduct. passes through midbr. diencephalon.

Dorsal portion of midbrain

four round swellings (lobes)

Corpora quadrigemina

## (3) Hindbrain

Integrate info. received from sensorimotor cortex of ear & audit. system

Pons

Cerebellum

Have fibres that cross that internorm. of the brain

very convoluted surface to provide additional space for neurons

Medulla / oblongata

connected to spinal cord

cardiovascular gain reflexes

Brain stem

mid brain

Medulla oblongata

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## Sensory Reception & Processing

Sense org. detect all types of changes in enviro. & send appropriate sign. to CNS.

↓  
Inputs processed & analyzed.

↓  
Sensing the environment

### Sense Organs.

NOSE

↓  
smell

↓  
contains mucus coated receptors

↓  
specialized for receiving the sense of smell & called olfactory receptors.

↓  
made up of olfactory epithelium & consists of three kind of cells.

↓  
The neurons of olfactory epithelium extends from outside enviro. directly into a pair of broad bean sized organs olfactory bulb.

↳ extensions of brain's limbic system.

TONGUE

↓  
taste

→ through taste buds.

↓  
contains gustatory receptors

\* Both nose & tongue detect dissolved chemicals.

\* The chemical senses of gustation (taste) & olfactory (smell) are functionally similar & interrelated.

\* With each taste of food or drink, the brain integrates the differential input from the taste buds & complex flavour is perceived.

### Reflex action & Reflex Arc

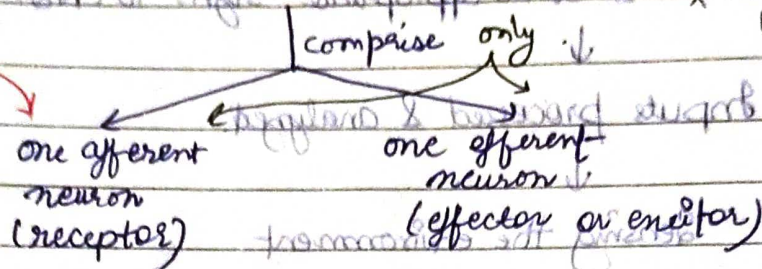
\* The entire process of response to peripheral nervous stimulation





that occur involuntarily i.e. without conscious effort or thought & requires the involvement of a part of CNS is called reflex action. ~~21) it is a rapid response & no interneuron involved.~~

sensory organ



via dorsal root ganglion → CNS

ventral root ganglion

at the level of spinal cord.

NOSE

The stimulus & response thus forms a reflex arc.

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The reflex arc is a neural pathway that controls a reflex. The sensory neuron carries the message from the receptor to the CNS. The motor neuron carries the message from the CNS to the effector. The interneuron is a neuron that connects the sensory neuron to the motor neuron. The reflex arc is a simple neural pathway that controls a reflex.

The entire process of response to peripheral nervous stimulation



## The Eye: Pair of Eye

## NCERT THREAD NOTES

In the pair of sockets in skull "orbita".

Eye - nearly spherical structure

Eye wall - composed of three layers

Retina

Three layers of neural cells

ganglion bipolar photorecep. cells  
inside to outside

contains light sensitive protein i.e. photopigms.

Rods

twilight (scotopic)

purplish red "rhodopsin" or "visual purple"

contains derivative of vitamin A.

Cones

Daylight (photopic &amp; colour)

Three types having own characteristic pigments

blue red green

Sensation of different colours is produced by various combinations of these cones &amp; their photopigments.

When equally, a sensation of white light produced.

Choroid

Many blood vessels &amp; looks bluish

This layer is thin over posterior 2/3rd portion of eye, but becomes thick in anterior part to form ciliary body.

ciliary body continues forward to form a pigmented &amp; opaque structure called iris

visible colour. portion of eye

Eye balls has transparent crystalline lens held in place by ligaments attached to ciliary body.

In front of lens, aperture surrounded by iris - pupil

diameter regulated by muscle fibres of iris.

Sclera.

\* Ext layer of eye is composed of cornea &amp; sclera

Ext. layer of dense connective tissue

The ant. portion of this layer is cornea.

\* The optic nerves leave retinal &amp; blood vessels enter the eye

a point medial to &amp; slightly above the posterior pole of the eye ball.

(Blind spot → no photoreceptor cells)

\* At posterior pole of eye lateral to blind spot is a yellowish pigmented spot called macula lutea with a central pit

fovea

thinned out portion of retina

\* only cones present

Visual activity / resolution is highest

\* B/w cornea &amp; lens → aqueous chamber → thin watery fluid → aqueous humor

\* B/w lens &amp; retina → vitreous chamber → transparent gel → vitreous humor





Date

Page

## Mechanism of Vision

Light rays focused on retina  
through cornea & lens gen  
erate impulse in rods & cones

photopigments

opsin

Retinal  
(aldehyde of  
Vit. A)

Light induces dissociation  
of retinal from opsin

Structure of opsin changes

Membrane permeability  
changes

P. d. generated in  
photoreceptor cells.

Image formed on  
retina (real)  
is recognized  
by earlier memory  
& experience.

neural impulse  
analysed (erect  
image  
in brain)

Signal produced.

Action pot. in  
ganglion cells

through bipolar  
cells.

Impulses  
transmitted  
by optic nerves

to visual cortex

Which part of ear determines pitch of sound?

COCHLEA

Which part of human brain is most developed?

FOREBRAIN

Which part of CNS acts as master clock?

HYPOTHALAMUS.



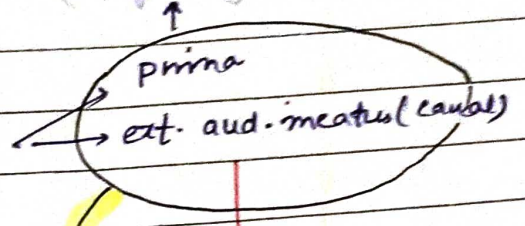
# The Ear: Two sensory funct

Body balance.  
Ka maintenance. → Hearing

collects vibr. in air → sound. <sup>prod.</sup>

## Anatomically divided

- Outer ear
- middle ear
- Inner ear.



extends up to tympanic membrane (ear drum).

has very fine hairs & wax-secreting glands

1) malleus 2) incus 3) stapes  
(chain like fashion)

attached to tympanic memb.

attached to oval window of cochlea.

Tympanic memb.

connective tissue memb cover. skin → outside.  
mucus memb. → inside

\* Ear ossicles increase efficiency of transmission of sound waves to inner ear

\* Eustachian tube

connects middle ear to pharynx.

equilibrates pressure on either sides of ear drum.

fluid filled inner ear - Labyrinth

filled with perilymph.

Bony labyrinth

series of channels

inside these channels is.

Memb. Labyrinth.

surrounded by perilymph filled with endolymph

coiled portion of labyrinth - cochlea.

Reissner memb.

Basilar memb.

divide perilymph of bony labyrinth.

upper scala vestibuli

lower scala tympani

terminates at round window → middle ear.

At base of cochlea

this ends at oval window

\* Space within cochlea - scala media - filled with endolymph.

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★

Organ of Corti → on basilar membrane → contain hair cells

in rows on the internal side of the organ of Corti.

basal end of hair cells in close cont. with afferent nerve fibres.

auditory Receptors

A large no. of processes called stereocilia are project. from apical part of each hair cell.

\* Above the rows of hair cells is a thin elastic memb. called tectorial memb.

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Inner ear → also contain a complex system

influenced by gravity & movement → "Vestibular Apparatus" above cochlea.

The three semicircular canals

membranous

mutually perpendicular

suspended in perilymph

Swollen Base - ampulla.

contains a projecting ridge

cresta ampullaris

has hair cells

Otolith

sacule

utricle

projecting ridge

macula (sensory part)

specific recept. of vestibular apparatus responsible for maintenance of balance of body & posture balance.

Mechanism of Hearing :

Ext. ear collects sound wave & directs to ear drum

ear drum vibrate

through ear ossicles

oval window

Impulse analyzed. Sound recognized.

Transmitted by afferent fibre via aud. nerve to auditory cortex of brain

fluid of cochlea (generated waves in lymphs)

nerve impulse in associated afferent neurons

presses against tectorial membrane.

hair cells bend

Ripples in basilar membr.